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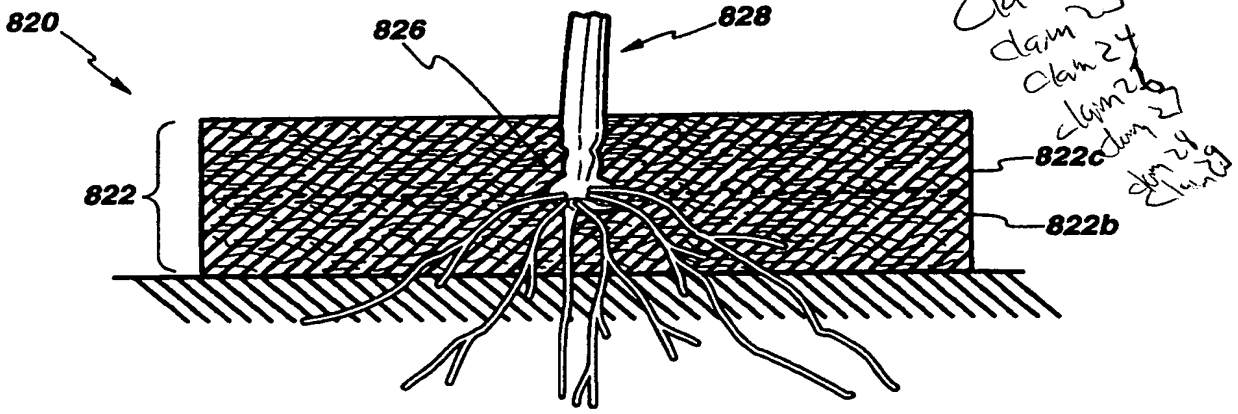

(57) Abstract

A plant germination mat (20) comprising a substrate (22, 24) including a structurally integral layer comprising sphagnum moss particles (22), and a plurality of seeds (26) situated on or incorporated into the substrate. The mat (20) is stored dry and in use is cut to a desired shape and spread over the land and watered. The amount of effort to be expended in cultivating the plants is reduced over the prior art. A method of growing plants comprising the steps of placing an appropriate plant seed germination mat (20) on the soil (36) and watering. A method of growing a flower bed having a pattern comprising the steps of severing two or more plant seed germination mats in accordance with the pattern, placing them on the soil in accordance with the pattern, and watering.

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PLANT SEED GERMINATION MAT

FIELD OF THE INVENTION

The present invention relates to plant seed germination mats.

BACKGROUND OF THE INVENTION

For many centuries, humans have attempted to cultivate plants and control and regulate plant growth. Over the years there have been many objectives for such cultivation and control. In present times, it might be desired to cultivate a lawn, a bed of flowers, a garden, or commercial cash crops.

No matter what the final objective, however, as a general rule plant cultivation and control involves getting specific plants to grow in specific locations and preventing others from growing in other locations. It is not an easy task. Plant cultivation, and particularly plant seed germination, requires that a number of variables including soil nutrient conditions, soil moisture content, and light and temperature levels all be within a suitable range. Such conditions are rarely optimal in nature, hence, in order to effect plant growth it is generally required that one must first prepare the soil through a variety of techniques, plant the seeds in the desired locations, fertilize the soil, and water as necessary depending on environmental conditions.

Each of these steps in and of itself is not simple. The soil must first be tilled and if necessary topsoil added. Depending on the size of the plot of land, machines might be available to aid in such work, otherwise such work might be time consuming and physically difficult. Hilly areas in particular may require an extreme amount of work, for which machine assistance may not be available. The seeds must then be planted, in the desired pattern.

The ground area in which the plant seeds are located must be kept wet, as the plant seeds will only germinate in relatively constant moisture conditions. Depending on the plants being grown the ground may be watered at either regular intervals or when it appears dry. Neither are particularly accurate methods for measuring soil moisture content. As with the fertilizer, water is dispersed over the ground relatively randomly, and thus, some areas may be overwatered, others underwatered, and still others not watered at all. In addition, water provided to the plants does not simply stay in the topsoil where the seeds are located, but rather will seep into the layers below becoming unavailable to the seeds. The amount of watering done must take such waste into account. The entire watering process thus is inefficient and wasteful.

Even once all of the above steps have been accomplished, the work has not ended. Birds and other small animals like to eat the seeds and continual efforts must be made to keep such animals away and to replace the seeds that have been eaten by them. Constant efforts must also be expended to maintain the area free of unwanted plant growth resulting from natural seed placement in the area or from seeds already present in the soil before the desired seeds were planted.

One way in which some of these difficulties have been previously attempted to have been overcome is through the production and use of sod. Sod is a small piece of a layer of turf that has been cut from the earth. It contains both mature plants (including roots) and a small layer of soil underlying them. Sod is generally used as quick means of producing a lawn (of grass). In order to do this, a number of pieces of sod are placed side-by-side over an area of the ground in which it is desired that the grass grow. It is then watered, and optionally fertilized, and it is hoped that the desired end will be achieved. There are, however, many problems with sod: As it must be grown as a crop, it takes a relatively long-time and large ground area to produce on a commercial scale. As it is a live plant, its soil component must be kept constantly moist in order to prevent it from dying before use. It is thus expensive and impractical to store for an

extended period of time. Moreover, in use it is heavy, dirty, time-consuming, and difficult to handle and requires lots of equipment. It often dies despite the best efforts of the user.

Another attempt to overcome these difficulties is through the creation and use of plant seed germination mats. In general terms, a plant seed germination mat is a sheet of one or more materials to which there has been affixed, or into which there has been incorporated, a plurality of plant seeds. Typically the sheet comprises a relatively thin layer of Kraft wood pulp, although other materials such as compacted coconut and straw have also been used. In use the mat is placed upon the (prepared) soil and is watered and (it is hoped at least) that the seeds will begin to germinate and the plant will grow. If the seeds are not affixed to the environment facing surface of the sheet, it will be necessary for the nascent plant shoots to be able to penetrate (*i.e.* grow through) the materials which cover them in order for the plant to survive.

The difficulty with conventional plant seed germination mats is that they are all almost non-absorbent. This presents a problem because seeds require a certain constant minimum level of moisture before they will germinate and begin to grow. It is thus becomes necessary to constantly water such mats. Another difficulty is that such mats relatively easily lose their cohesion and they thus tend to break apart before and during use into clumps of their base material losing the seeds in the process.

One attempt to solve such problem, and to retain water within the mat, has been the incorporation therein of absorbent polymers, such as hydrogels. This solution, however, has not been wholly satisfactory. One particular problem is that mats containing such polymers have a relatively short shelf-storage life, as the polymers tend to lose their absorbency after about six months. Even if the mats are employed during the useful lifetime of the polymers, the polymers still do not render that much water available to the seeds. Thus while the situation has been ameliorated, it has not been

eliminated. Finally, some polymers render the mats relatively stiff and thus such mats do not conform well to soil surfaces that are not flat.

In sum, at present the plant cultivation, control, and regulation process is a difficult one. Efforts made to alleviate these difficulties have not met with complete success. It would be desirable to devise a means, method and/or apparatus for reducing the amount of work and materials required to cultivate, control and regulate plant growth, and particularly to improve upon conventional plant seed germination mats.

OBJECT AND STATEMENT OF THE INVENTION

It is therefore an object of the present invention to provide a means and a method for cultivating, controlling, and regulating plant growth requiring less work and materials than is conventionally required.

It is also a further object of the present invention to provide an improved plant seed germination mat.

In first aspect, as embodied and broadly described herein, the present invention provides a plant seed germination mat comprising:

(a) a substrate, said substrate including a structurally integral layer comprising sphagnum moss particles;

(b) a plurality of plant seeds situated on said substrate; and

(c) a cover layer affixed to said substrate at least partially covering said substrate and said plant seeds, said cover layer capable of being gradually penetrated by a shoot growing from one of said plant seeds.

Structurally integral sphagnum moss layers similar to those of the present invention have been manufactured for some time for use in articles used to absorb

bodily exudates (*e.g.* feminine sanitary napkins, tampons, medical bandages, Band-Aids™). Sphagnum layers are employed in such articles owning to their excellent liquid absorption properties; they are capable of absorbing and retaining a significant amount of liquid over periods of time. They are, however, stored dry. Such layers and the manufacture thereof are described in International Patent Application WO 97/13484 (Roy *et al.*) published on April 17, 1997. This document is herein incorporated by reference.

These properties of the sphagnum layers allow the present invention to be a significant improvement over conventional plant cultivation techniques. The present germination mats may be manufactured on large scale as relatively large yet lightweight sheets, they may be rolled upon themselves into a roll and stored dry for extended periods of time if necessary, enabling long-term storage while decreasing both storage and transportation costs (as compared with sod).

More significant benefits accrue to the end user of the present mats. In effect, the present invention allows the user to dispense with the steps of tilling the soil, positioning and planting the seeds, and fertilizing. All that is necessary is that the user unroll the present germination mats, sever them to the desired shape and size (as necessary), place them on the soil and apply water to the mats to maintain sufficient moisture content to promote seed germination and growth. Depending on the mat and the particular species of seed, the seeds may have been precisely placed within the mat at desired locations, or may have been randomly placed, thus simplifying the seed placement process. Moreover, the amount of work necessary to maintain the seeds is also decreased. The structurally integral sphagnum layers of the present invention will absorb and retain a large amount of water, as opposed to simply allowing it to seep through to the ground underneath. The plant seeds of the present invention therefore effectively have water constantly available to them, presenting a more suitable condition for seed germination, and likely increasing the germination rate. The amount

of weeding required is reduced as the present germination mats contain only the plant seeds which were intentionally placed in them during their manufacture. Other plant seeds present in the soil below are less likely to germinate, as the present mats will greatly decrease the amount of sunlight and water available to them. Furthermore, as the present plant seeds are shielded by the cover layer of the present germination mat, they are much less likely to be disturbed by animals in the area. In addition, as the sphagnum layers decay they will constitute a natural fertilizer and make nutrients available to the sprouting seedlings. The present germination mats are thus a significant development in plant cultivation.

A plant seed consists of a dormant embryo, together with a quantity of stored food which may be absorbed in the embryo, or may surround it, and one or two seed coats or integuments. The embryo of typical plant consists of a stemlike axis bearing either one or two cotyledons. The cotyledons, sometimes referred to as the seed leaves, are the first leaves of the young saprophyte. As the names imply, the embryos of monocotyledons commonly have one cotyledon and those of dicotyledons, two.

At opposite ends of the embryo axis are found the apical meristems of the shoot and the root. The apical meristems are found at the tips of all shoots and roots. In some embryos, only an apical meristem occurs above the cotyledon or cotyledons. In others, an embryonic shoot, consisting of a stemlike axis called the epicotyl, with one or more young leaves and an apical meristem, occurs above the cotyledon. This embryonic shoot, the first bud, is a called a plumule.

The stemlike below the cotyledons is referred to as the hypocotyl. At the lower end of the hypocotyl there may be an embryonic root, or radicle, with distinct root characteristics. When germination occurs, the first structure to emerge from most seeds is the radicle; this enables the developing seedling to become anchored in the soil and to absorb water.

The way in which the shoot emerges from the seed during germination varies from species to species. For example, after the root emerges from the seeds of the garden bean, the hypocotyl elongates and becomes bent up in the process. When the bend, or hook, reaches the soil surface, it straightens out and pulls the cotyledons and plumule up into the air.

By contrast, in the pea, the epicotyl is the structure that elongates and forms the hook. As the epicotyl straightens out, the plumule is raised above the soil surface. The cotyledons remain in the soil where they eventually decompose.

In the onion, it is the single tubular cotyledon that emerges from the seeds and forms the hook. When the cotyledon straightens, it carries the seeds coat and enclosed endosperm upwards.

In corn, a monocot that has a highly differentiated embryo, both radicle and plumule are enclosed in sheathlike structures, the coleorhiza and the coleoptile, respectively. The coleorhiza is the first structure to grow through the pericap (mature ovary wall) of the corn grain. The coleorhiza is then followed by the radicle, or primary root, which elongates very rapidly and quickly penetrates the coleorhiza. After the primary root emerges, the cleoptile is pushed upward by elongation of the first internode, called the mesocotyl. When the base of the coleoptile reaches the soil surface, its edges spread apart at the tip, and the first leaves of the plumule begin to emerge.

As different plants germinate differently, in the context of the present invention it should be understood that the term "shoot" will encompass the first portions of the plant which emerge from the germinating seed and penetrate the cover

layer of the mat. Thus, depending on the particular seed in question, a shoot may be a cotyledon, hypocotyl, epicotyl, or cleoptile, etc.

Preferably, the cover layer includes a structurally integral layer comprising cellulose fibres, particularly wood pulp fibres. Such a cover layer would serve to secure the seeds within the mat, to protect the seeds during the primary stages of their growth and to impede their being eaten by birds and other animals.

More preferably, the cover layer includes a structurally integral layer comprising sphagnum moss particles. Such a layer would increase the aforementioned benefits conferred by the sphagnum moss particles, *i.e.* more water may be retained by the mat, less water and sunlight pass through the mat, and more natural fertilizer is available as the sphagnum decays. Such a layer would also constitute a greater prevention from unwanted animal interference with the seeds below. The reason for this is that a sphagnum moss cover layer is generally thicker and denser than a simple cellulose fibre cover layer.

Depending on the type of plant seeds and the construction of the cover layer, the growing plant shoots may not be strong enough to penetrate the cover layer. There is, however, no precise mathematical way to determine before hand whether or not this is the case. Much depends on the constituents of the cover layer and its basis weight. Generally, where the cover layer comprises natural (*i.e.* non-synthetic) constituents it will be penetrable by a large majority of shoots over a broad range of basis weights (*e.g.* those of between 50 and 500 grams per square meter). Another factor is the nascent plant shoot strength. In this respect, generally, the smaller the diameter of the plant seed, the weaker the shoot will be; the converse is also true.

For this reason, the layers described in Roy, however, can rarely be used as described therein (without alternation) in the production of a seed germination mat.

The difficulty is that these layers contain significant amounts (approximately 1% to 4% on a dry weight basis) of polyester, which typically increases the structural integrity of the mat beyond a point at which it can be penetrated by a growing plant shoot. Indeed, all but the strongest nascent plant shoots (*e.g.* beans) are too weak to penetrate such a layer. The seeds will germinate but the plant shoots will die, trapped by the sphagnum cover layer. It is therefore preferable that the present plant seed germination mats not comprise polyester, or other similar synthetic materials.

Where the cover layer does contain synthetic material and/or it has a high basis weight (exceeding 500 grams per square meter) and/or contains week seeds, the cover layer preferably includes a plurality of perforations. Thus plant shoots not able to penetrate the cover layer will grow sideways, in between the cover layer and the substrate, and will exit the germination mat through one of the perforations. For this reason, the perforations need not be aligned with plant seeds, and the seeds may be randomly situated in the mat. Moreover, the placement of the perforations permits assisting in the selection of the position of the mature plants which develop from the seeds. In some situations, *e.g.* a lawn, the perforations are preferably evenly spaced apart, generally in rows and in columns. In other situations, it may be desired to produce a pattern out of the mature plants, and the holes may be placed so as to cause the mature plants to be of such a pattern. If mature plant placement is crucial, a seed germination mat should be selected which both has a cover layer of sufficient basis weight and constituent elements so to be impenetrable by the shoots of the seeds of the mat such that the shoots are forced to grow through the perforations, and has the desired perforation placement.

Another difficulty with synthetic materials is that they are typically non-biodegradable, such fibres will accumulate in the soil after successive use of several mats, eventually hindering plant growth. For this reason, the mat is substantially free

of non-biodegradable material, and in particular polyester, in order to render the entire present germination mat biodegradable and thus more environmentally friendly.

The cover layer may be affixed to the substrate by any conventional means which are non-toxic to the plant seeds and mature plants. Preferably such means are biodegradable, glues are preferred. No particular sealing pattern is essential to the present invention, however it should be noted that the cover layer and substrate should not be completely affixed to another to allow sideways plant shoot growth to a perforation in the cover layer (at least, where such is desired). If the plant seeds are completely surrounded by the affixation means, *e.g.* glue, and their shoots are not strong enough to penetrate the cover layer, then they will have the undesired consequence of dying within the mat. Furthermore, the seeds should not be encased in non-water soluble glues, those which are latex based for example, as no water will ever reach the seeds, and thus they will never germinate.

Preferably, the mat further includes a fertilizer. Such may be necessary where soil conditions are particularly poor in the area. Any conventional fertilizer which will not harm the seeds may be used. Such fertilizer may be impregnated into either the substrate or the cover layer (or both) during the course of manufacture thereof, or alternatively, may be dispersed (either in solid or liquid form) along the substrate in a similar manner as with the plant seeds.

Preferably, the mat includes an indicator of the variety of the seeds, and all conventional indicators are within the scope of the present invention. Thus, for example, the name of the variety might appear on either the cover layer or the substrate. It is more preferred that at least a zone of the cover layer be coloured to indicate a variety of the seeds.

Preferably, the mat includes an indicator of the in use position of the mat, and all conventional indicators are within the scope of the present invention. In this manner, the mat may be correctly positioned when in use, i.e. with the substrate in contact with the ground and the cover layer facing the environment. It is more preferred that such indicator be a colour of at least a portion of the cover layer or of the substrate. The perforations of the cover layer may also act as an indicator in this respect.

Preferably, the cover layer includes an indicator of the moisture content of the cover layer, and all conventional indicators are within the scope of the present invention. In this manner, it will be easier to discern when the mat (and thus the seeds) should be watered. Such an indicator may be a substance added to at least a portion of the cover layer which turns different colours when wet and when dry. Sphagnum itself is such a material (it being darker when wet and lighter when dry) and thus when the cover layer is a structurally integral sphagnum layer, it may not be necessary to add an additional material to the mat to serve as such an indicator.

Preferably, at least a portion of the cover layer approximates a colour of at least a flower of a plant grown from the seeds. In this manner a carpet or field effect may be created, such that, as an example, where the mature flowers are yellow, the cover layer of the mat is dyed yellow so that the entire area appears yellow instead of having yellow flowers with brown patches in between. It should be understood whenever in the context of the present invention a dye is added to the mat or any layer thereof, the dye should be non-toxic to both the seeds and the mature plants.

In still another aspect, as embodied and broadly described herein, the present invention comprises a plant seed germination mat comprising:

(a) a substrate, said substrate including a structurally integral layer comprising sphagnum moss particles, said substrate capable of being gradually penetrated by a growing shoot; and

(b) a plurality of plant seeds incorporated into said substrate.

In this embodiment the plant seeds are physically incorporated into the substrate, thus the substrate both supports and covers the seeds. In all other aspects, this embodiment is similar to that described above, including the colouring of the substrate for various purposes, and the addition of fertilizer thereto.

In another aspect, as embodied and broadly described herein, the present invention provides a plant seed germination mat comprising:

(a) a structurally integral layer of sphagnum moss particles; and

(b) a plurality of plant seeds affixed to said layer with sufficient force to keep said seeds from separating from said layer when said layer is subjected to mechanical disturbances occurring during either one of rolling said layer upon itself and unrolling said layer.

In this embodiment the plant seeds are affixed to one side of a structurally integral layer of sphagnum moss particles. Any conventional, non-toxic means of affixation may be used. Thus, the layer may serve as a substrate, if the mat is placed on the ground with the seeds facing the environment, or alternatively, may serve as a cover layer, if the mat is placed on the ground with the seeds facing the soil.

In yet another aspect, as embodied and broadly described herein, the present invention comprises a method of growing plants comprising the steps of placing a plant seed germination mat as previously recited on soil, and then watering the mat.

In still another aspect, as embodied and broadly described herein, the present invention still further comprises a method of making a plant seed germination mat comprising the steps of:

(a) providing a substrate including sphagnum moss particles;

(b) delivering a plurality of plant seeds on the substrate;

(c) providing a cover layer on the plant seeds, the cover layer capable of being gradually penetrated by a growing shoot; and

(d) affixing the cover layer to the substrate.

The cover layer may be affixed to the substrate by any conventional means which are non-toxic to the plant seeds and mature plants. Preferably such means are biodegradable, glues are preferred. No particular sealing pattern is essential to the present invention, however it should be noted that the cover layer and substrate should not be completely affixed to another to allow sideways plant shoot growth to a perforation in the cover layer.

In yet another aspect, as embodied and broadly described herein, the present invention provides a method of making a plant seed germination mat comprising the step of incorporating plant seeds into a structurally integral layer comprising sphagnum moss particles.

In still yet another aspect, as embodied and broadly described herein, the present invention provides a method of producing a plant bed having a pattern comprising the steps of

(a) providing a first seed germination mat as previously described;

(b) severing the first seed germination mat in accordance with the pattern; and

(c) positioning the severed first seed germination mat on soil in accordance with the pattern.

Optionally,

(a) providing a second seed germination mat as previously described;

(b) severing the second seed germination mat in accordance with the pattern; and

(c) positioning the severed second seed germination mat on soil in accordance with the pattern.

This aspect of the present invention allows the formation of complicated plant patterns (colour variations) more easily than is conventionally done. A desired pattern is selected and pieces of a germination mat of the present invention are severed and placed on the soil in accordance therewith. It should be noted that the number of different types of plants (*i.e.* germination mats containing different plant seeds) which may be used in this manner is not limited to two. Depending on the size of the area to be cultivated, a large number of different germination mats may be used.

Other objects and features of the invention will become apparent by reference to the following description and the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of preferred embodiments of the present invention is provided hereinbelow with reference to the following drawings, in which:

Figure 1 is perspective view of a plant seed germination mat;

Figure 2 is a top plan view of the mat of Figure 1, with a portion of the cover layer cut away to reveal the substrate;

Figure 3 is a cross-sectional side view of a plant seed germination mat including a germinated seed;

Figure 4 is a perspective view of a plant seed germination mat including germinated seeds;

Figure 5 is a cross-sectional side elevational view of a plant seed germination mat including a germinated seed having roots;

Figure 6 is a cross-sectional side view of a second embodiment of a plant seed germination mat similar to Figure 5;

Figure 7 is a cross-sectional side view of a third embodiment of a plant seed germination mat similar to Figure 5;

Figure 8 is a cross-sectional side view of a fourth embodiment of a plant seed germination mat similar to Figure 5;

Figure 9 is a perspective view of a flowerbed having a design having been formed through the use of plant seed germination mats;

Figure 10 is a schematic diagram of the apparatus for the manufacture of a structurally integral sphagnum moss layer; and

Figure 11 is a schematic diagram of the apparatus for the manufacture of a plant seed germination mat of the present invention from the structurally integral sphagnum moss layers manufactured as per Figure 10.

In the drawings, preferred embodiments of the invention are illustrated by way of example. It is to be expressly understood that the description and drawings are only for purposes of illustration and as aid to understanding, and are not intended to be a definition of the limits of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Fig. 1, in a preferred embodiment, the present invention comprises a plant seed germination mat 20. The mat may be of any shape and size as is feasible to manufacture, manipulate, and store. It is illustrated in the drawings as a relatively small square merely for discussion purposes. The mat 20 is of a laminate construction and comprises two distinct layers, a substrate 22 and a cover layer 24. In its in use position the substrate 22 will be in contact with the soil 36 and the cover layer 24 will face the environment.

Referring to Figure 5, both the substrate 22 and the cover layer 24 comprise four different sublayers. With respect to the substrate 22, in order from soil contacting sublayer up, these are a first wood pulp sublayer 22a, a first structurally integral sphagnum layer 22b, a second structurally integral layer 22c, and a second wood pulp layer 22d. The overall basis weight of the substrate is approximately 308 g/m^2 (including approximately 12% moisture content). The basis weights of the individual sublayers are approximately as follows: the first wood pulp sublayer 22a, 15 g/m^2 (including approximately 12% moisture content); the first structurally integral sphagnum layer 22b, 139 g/m^2 (including approximately 12% moisture content); the second structurally integral sphagnum layer 22c, 139 g/m^2 (including approximately 12% moisture content); and the second wood pulp sublayer 22d, 15 g/m^2 (including approximately 12% moisture content).

Similarly, the cover layer 24 comprises a first wood pulp sublayer 24a, a first structurally integral sphagnum sublayer 24b, a second structurally integral sphagnum sublayer 24c, and a second wood pulp sublayer 24d. The cover layer 24 has an overall basis weight of approximately 175 g/m^2 (including approximately 12% moisture content). The basis weights of the individual sublayers are approximately as follows: the first wood pulp sublayer 24a, 12 g/m^2 (including approximately 12% moisture content); the first structurally integral sphagnum layer 24b, 75.5 g/m^2 (including approximately 12% moisture content); the second structurally integral sphagnum layer 24c, 75.5 g/m^2 (including approximately 12% moisture content); and the second wood pulp sublayer 24d, 12 g/m^2 (including approximately 12% moisture content).

As can be seen in Figs. 1, 2 & 4, the cover layer 24 includes a plurality of evenly-spaced apart perforations 30. The perforations 30 are in the shape of an "X" and are aligned along a grid 1 cm apart (as measured along a line 32 from perforation centre to

perforation centre). The length of each of the bars 30a of the perforation 30 is 0.65 cm while the inter-bar distance 30b at the top of the perforation 30 is 0.5 cm.

Situated between the substrate 22 and the cover layer 24 are a plurality of plant seeds 26. The plant seeds 26 are flowering plant seeds 26, preferably flowering plant seeds of mixed variety currently sold by White Swan Inc. of Beaverton, Oregon, USA under the trademark FIELD OF FLOWERS™. The plant seeds 26 have been randomly dispersed along the substrate 22 with a seed density of 645 seeds/m^2. There is no particular relationship of the placement of the plant seeds to the perforations.

The substrate 22 and the cover layer 24 are affixed with conventional hot melt type glue (not shown), such as that sold by the National Starch & Chemical Corporation (Plainsfield, NJ, USA) under the designation 34-5599. No particular gluing pattern is essential to the present invention. Most preferably, the bonding pattern is intermittent to allow for sideways shoot growth between the substrate and the cover layer.

The fabrication of the germination mat 20 first proceeds with the manufacture of the individual layers of which it is comprised. Referring to Figure 10, the manufacturing apparatus, designated comprehensively by the reference numeral 100, comprises an endless, fluid-pervious Fourdrinier wire 102 which is mounted on rollers 104 to provide a horizontally extending run 108 that is continuously advanced forward to support and convey a slurry of sphagnum moss and cellulosic fibers through various processing stations.

Headboxes 110, 112, 114 and 116 arranged in a spaced apart relationship along the path of travel of the wire 102 are provided to lay on the wire 102 slurry in sheeted form. The headbox bank deposits on the wire 102 four (4) layers of slurry in a superposed relationship to form a laminated slurry web. More specifically, the headboxes 112 and 114

dosage amount
claim 24

lay slurries containing sphagnum moss while the headboxes 110 and 116 deliver slurries of fibrous material such as Kraft wood pulp or any other suitable substance.

In the preparation of the sphagnum moss slurry layers supplied to headboxes 112 and 114 a mother slurry is prepared by dispersing raw sphagnum moss material in water. The mother slurry is wet classified to retain only the particles having a size in the range from about 74 microns to about 2000 microns. The screened fraction is then diluted with water to render the slurry more manageable.

It is preferred to add a fibrous component, such as Kraft wood pulp prior to supplying the slurry to headboxes 112 and 114. Suitable fibrous components may include such materials as Kraft wood pulp, cross-linked cellulose fibers, mechanical wood pulp, natural textile fibers, and mixtures thereof. The fibrous components are generally added to the headbox in an amount from 2 to 10% by weight of the sphagnum layer to be manufactured, preferably from 2% to 6%. As used herein, the term mechanical wood pulp is meant to include ground wood pulp, thermo-mechanical pulp and refiner wood pulp. Ground wood pulp is essentially trees and branches which have been debarked, cleaned and ground into particulate matter. Refiner wood pulp differs from ground wood pulp only in that the grinding step utilizes a refiner, i.e. a disc-like device well-known in the art and having metallic ribs at the peripheral sections thereof which last contact the wood particles and help separate the wood fibers without excessively damaging them. Thermo-mechanical wood pulp is similar to refiner pulp with the exception that the wood particles are heated in the refiner, usually with steam, to aid in separating the wood fibers. The common characteristic of these mechanical pulps is that no attempt has been made to separate the fibers by chemical means although they may later, after being reduced to fine particulate matter, be subjected to a desired chemical treatment, such as bleaching. Preferably, when mechanical wood pulp is used in a sphagnum moss slurry, such mechanical pulp has a Canadian Standard Freeness (TAPPI test method T-227), in a range of from about 60 to 750 and preferably from about 400 to 600.

The Kraft wood pulp, also usable in combination with sphagnum moss, is essentially chemically treated, long fibred wood pulp such as sulphite and sulphate wood pulps.

As illustrated in Figure 10, a slurry of Kraft wood pulp layer having a consistency of about 0.2% by weight of solids is first laid down on the wire 102 from the headbox 110 in order to form the bottom Kraft reinforcing layer 22a. The slurry flow rate is selected to deliver on the wire 102, about 13.2 grams of solids per square meter, to form a Kraft layer a basis weight of about 15 g/m^2 (including approximately 12% moisture content.).

The Kraft slurry passes under the headbox 112 which delivers on top of the Kraft layer a slurry of sphagnum moss particles intermixed with cellulosic cross-linked fibers. The slurry contains sphagnum moss in the range from about 90% to about 98% by weight of solids in the slurry, and cross-linked cellulosic fibers in the range from about 10% to about 2% by weight. The consistency of the slurry fraction is set at about 0.5% by weight of solids. The flow rate of the slurry fraction is selected to deliver about 122.5 grams of solids per square meter on the wire 102, thus forming a sphagnum layer having a basis weight of about 139 grams per square meter (including approximately 12% moisture content).

The headbox 114 delivers a second slurry fraction of sphagnum moss particles intermixed with cellulosic cross-linked fibers, the same as that described above in relation to headbox 112. This slurry fraction also has a consistency of about 0.5% by weight of solids, and its flow rate is also selected to deliver about 122.5 grams of solids per square meter on the wire 102, thus forming a second sphagnum layer having a basis weight of about 139 grams per square meter (including approximately 12% moisture content).

The resulting Kraft/Sphagnum/Sphagnum slurry is then passed over a vacuum slot 118a to extract water under the influence of a pressure differential established across the slurry layer. It is necessary to regulate the residence time of the slurry layer over the vacuum slot 118a and the vacuum intensity in order to control the density of the final product. Generally, decreased vacuum and increased speed will result in a less dense product. Conversely, increased vacuum and decreased speed will produce a denser product. The preferred pressure is about -6.2 kPa (25 in of H_2O) and the preferred retention time is approximately 18 seconds.

A final Kraft wood pulp slurry layer is laid from the headbox 116 on the sphagnum moss slurry in order to form the reinforcing top layer 22d. This final layer was identical in terms of consistency and composition to the bottom Kraft wood pulp layer 22a previously deposited. The flow rate is also selected so as to deposit about 13.2 grams of solids per square meter, to yield a Kraft layer having a basis weight of 15 grams per square meter (including approximately 12% moisture content.). The final resultant laminated Kraft/Sphagnum/Sphagnum/Kraft slurry passed over two vacuum slots 118b, 118c to extract water as described above. The preferred pressure of the first 118b is about -6.2 kPa and the preferred retention time is approximately 6 seconds. The preferred pressure of the second 118c is between about -40kPa and -60kPa and the preferred retention time is about 3 seconds. It should be understood however that there are many vacuum slot configurations that would suffice.

The laminate may then optionally be treated with surfactant to increase the rapidity with which the mat will absorb water. In this respect, any conventional surfactant may be applied, as long as it is non-toxic to the plant seeds to be incorporated into the mat. An example is the surfactant sold by the BASF Corporation of Toronto, Ontario under the designation TETRONIC™ 701.

The laminate may then optionally be passed through a press section (not shown) to mechanically express water from the web, as is well-known to those skilled in the art, in order to reduce the water contents in the web as much as possible before it is processed in the dryer 120.

The laminate is then passed through a conventional dryer 120 wherein the moisture content thereof is reduced to approximately 12% (by weight). (Before passage through the dryer the laminate may optionally be pre-heated (to assist in drying) by any number of conventional techniques. An example is passing steam through the laminate, either under pressure or by vacuum.

Downstream of the dryer 120 a calendering station 122 is provided which mechanically compresses the dried product in order to densify and reduce the thickness of the laminate structure.

The fabrication of the cover layer 24 proceeds in a similar manner except that the material deposition rates have been suitably altered to provide a cover layer 24 with the basis weight, as described above in the description of the cover layer 24 itself. (In order to produce a mat having a final moisture content of approximately 12% by weight, a flow rate (in terms of grams of solids per square mater) of about 88% of the final basis weight of the layer (also in terms of grams of solids per square meter), is selected.) Additionally, at the end of the process, the cover layer 24, may optionally be perforated through conventional means, *e.g.* punching or die cutting. A grid-like perforation pattern as previously described is preferred.

Referring to Figure 11, the germination mats 20 are manufactured by providing the dry substrate 22 on a endless belt 124 (Possibly, as shown in Figure 10, directly after their manufacture.) As the belt 124 moves forward, the dry substrate 22 is first passed through a gluing stationing 126 where glue is applied thereto in the desired

gluing pattern. Next, seeds (stored in a hopper 128) are situated on the substrate 22, also in the desired pattern. Such pattern may be random or may be precise. In the preferred embodiment the seeds are flowering plant seeds randomly dispersed at a density of approximately 645 seeds/m^2. The seeds may be grass seeds, in which case they would be randomly dispersed at a density of approximately 30,000 seeds/m^2. The may also be vegetable seeds, in which case the might be randomly or precisely dispersed. As an example, they might be "bean" seeds randomly dispersed at between about 100 and 200 seeds/m^2. The cover layer 24 is then aligned with the substrate 22 and placed on top thereof 130. Optionally, the final product is then manipulated for storage and transport, which may include rolling or slicing into smaller pieces.

Referring to Figure 6, there is shown an alternative embodiment of the invention, wherein the substrate 622 and the cover layer 624 each consist solely of a single structurally integral layer of sphagnum moss particles. The substrate 622 has a basis weight of between about 100-300 g/m^2 (including approximately 12% moisture content). The cover layer 624 also has basis weight of between about 100-300 g/m^2 (including approximately 12% moisture content). Typically, basis weights at the lower end of each of these ranges are preferred, as they are less expensive to manufacture. Higher basis weight layers will be used where more water is required to be available to the seeds. (The higher the basis weight the more water which may be absorbed by the mat.) Higher basis weight layers will also be used where the seeds are so large (*e.g.* greater than 7 mm) so as to pierce holes when pressure is applied to mats of lower basis weight layers. (Higher basis weight layers have greater cohesion and structural integrity.)

This embodiment is manufactured similarly to that described above. Referring to Figure 10, headboxes 110, 114 and 116 are not used. A slurry of sphagnum moss particles (as described above) is delivered to headbox 112, intermixed with the sphagnum particles is a fibrous component (also as described above) such as Kraft wood pulp. In this embodiment, owing to the lack of external Kraft layers, it is preferred

that the fibrous component be added in an amount from about 10-30%, and preferably from about 15-20% of the weight of the layer to be manufactured. The slurry is then laid down upon the Fourdrinier 102 from the headbox 112. The consistency of the sphagnum moss slurry fraction is set at 0.5% by weight of solids. The flow rate of the slurry fraction is selected to deliver the appropriate amount to yield a sphagnum layer having the desired basis weight. The downstream processing is as described above. This layer will become the substrate 622. Similarly the same apparatus is used to manufacture the cover layer 624 except that the flow rate of the slurry fraction is selected to deliver the appropriate amount to yield a sphagnum layer having the appropriate basis weight. The downstream processing is also as described above. This layer will become the cover layer 624. The substrate 622 and cover layer 624 are then processed as described above in relation to Figure 11, to form a plant seed germination mat 620.

Referring to Figure 7, in another alternative embodiment of the present invention, the seeds 726 of the germination mat 720 have simply been affixed to the underside of a structurally integral sphagnum layer 722. (Illustrated as being of a reduced thickness as compared with the substrates 22 and 622). Such layer 722 forms a cover layer over the seeds 726 and no substrate is present. Such mats may be manufactured as previously described (in Figure 10) with the seeds being affixed to one side thereof with conventional non-toxic glue during the manufacturing process (such side will preferably become the soil-facing side [underside] of the mat when the mat is in use.)

Referring to Figure 8, in another alternative embodiment of the present invention, the seeds 826 of the germination mat 820 have been incorporated into the structurally integral sphagnum layer 822. The structurally integral sphagnum layer may be notionally separated into a lower layer 822b and an upper layer 822c, in reference to the layer's relative position with respect to the seeds 826. (By "notionally" it is meant

that the lower layer 822b and upper 822c are not distinct structurally integral layers (as in the embodiment shown in Fig. 6), rather both together form a single structurally integral layer. They are not materially distinguishable from one another in the final layer.) The structurally integral sphagnum layer 822 does not have Kraft layers on either of its surfaces nor does the germination mat of this embodiment have any cover layer.

With reference also to Figure 10, this embodiment is manufactured as follows: The apparatus of Figure 10 is generally employed except that only headboxes 114 and 116 are preferably used. (The germination mat of the present embodiment does not contain the fibrous material (*e.g.* Kraft) layers, so headboxes 110 and 112 are not necessary.) Headboxes 114 and 116 each contain a slurry consisting of about 0.8% by weight solids being about 70-90% by weight sphagnum moss / about 30-10% by weight Kraft wood pulp, prepared as previously described. Intermediate the headboxes 114 and 116, after vacuum slot 118a, is a hopper akin to hopper 128 in Figure 11 which supplies seeds.

A first slurry from headbox 114 is laid down upon the wire 102. The flow rate of the slurry is selected to deliver about 9 to 90 grams of solids per square meter upon the wire, 45 grams of solid per square meter being most preferred. (Forming a layer having a basis weight of 50 grams per square meter (including approximately 12% moisture content.) It is these solids which will form the bottom layer 822b of the structurally integral sphagnum layer 822. The slurry is passed over the vacuum slot 118a (pressure about 6.2 kPa). Subsequently, seeds are randomly or precisely placed upon the slurry to yield a seed density of approximately 645 seeds/m^2 (for flowering plant seeds), 30,000 seeds/m^2 (for grass seeds), and 100-200 seeds/m^2 (for vegetable plant seeds). Next, a second slurry (similar to the first) is laid down upon the first slurry/seed combination from headbox 116. The flow rate of the slurry is selected to deliver between about 45 to 450 grams of solids per square meter. It is these solids

which will form the upper layer of 822c of the structurally integral sphagnum layer 822b. The preferred values for this flow rate are dependent upon the actually seeds to be incorporated into the mat, as the upper layer 822c must be capable of being penetrated by a shoot, yet preferably has a high enough basis weight to cover the entire seed. For small seeds (*i.e.* seeds with a diameter of less than 3 mm), the preferred flow rate is 135 grams of solids per square meter (yielding an upper layer having a basis weight of 150 grams of solids per square meter (including approximately 12% moisture content); for medium seeds (*i.e.* seeds with a diameter of between 3 and 7 mm), the preferred flow rate is 175 grams of solids per square meter (yielding an upper layer having a basis weight of 200 grams of solids per square meter (including approximately 12% moisture content); and for large seeds (*i.e.* seeds with a diameter of greater than 7 mm), the preferred flow rate is 265 grams of solids per square meter (yielding an upper layer having a basis weight of 300 grams of solids per square meter (including approximately 12% moisture content). Examples of small seeds include varieties of the plants commonly known as chive, basil, marjoram, and dill. Those of medium seeds include varieties of the plants commonly known as radishes and tomatoes. Those of large seeds include varieties of the plants commonly known as corn, peas, and squash.

Although not shown in the drawings, it would be possible (before further treatment of the laminate) to add additional layers of seeds and sphagnum (in a similar manner to that described above) to produce plant seed germination mats having alternating layers of sphagnum and seeds.

The resultant product is then manipulated as was described above (including passage over vacuum slots 118b, 118c) however, it is necessary to control the temperature of the dryer 120 so as not to exceed about 110°C, and not to pass through the calendering rollers 122, to prevent the seeds from being damaged by the heat/pressure (respectively) thereof.

The use of the germination mat 20 (or 620 or 720 or 820) is relatively simple. First, a plot of land on which the plants will be grown is selected. No particular amount or shape of land is necessary for the use of the present invention. Any plot of land will suffice as long as the soil thereof is capable of sustaining plant life. It is preferred that the topsoil thereof by lightly tilled before the germination mat 20 be applied thereto, but such is not essential.

Next a germination mat having the desired characteristics must be selected. Such characteristics are generally the following: type and arrangement of plant seeds present in the mat, presence and type of a fertilizer present in the mat, colour(s) of mat, watering requirements of mat, etc. Each of these variables will be selected as a function of both the environment of the plants to be grown and the wishes of the cultivator. Primarily, the germination mat 20 must contain the plants seeds desired to be grown and have same be present in the appropriate layout. For example, if it is desired to grow grass, a germination mat having grass seeds randomly dispersed throughout should be selected. Alternatively, if it is desired to grow marigolds in a rows, then a germination mat having marigold seeds in that configuration should be selected. Optionally, the germination mat 20 may contain additional ingredients such as a fertilizer. Depending on the amount of land to be covered and the size of the germination mat, more than one mat may be necessary.

The mats are generally stored dry in rolls. If necessary, they must be unrolled and are then severed into the desired shape and size to cover the desired amount of land. Any conventional means such as garden shears or even scissors may be used to severe the mats 20. They are placed on the soil with the substrate 22 in contact with the soil 36 and the cover layer 24 facing the environment. They are then watered until they are soaked full of water (absorbed by the integral sphagnum layers). The cover layer 24 will act as an indicator of the moisture content of the germination 20, as the sphagnum thereof will turn dark when full of water.

The mats and the plants which grow therefrom are then cared for in the same manner as would be ordinary seedlings. Generally this care will include periodic watering (the necessity of which may be judged by the colour of the sphagnum cover layer), weeding, and in some cases, the application of fertilizer.

Referring to Figures 3 and 5, after a short period of time the plant seeds 26 will begin to germinate and a plant shoot 28 will grow forth and exit the mat 20 either by simply growing through the cover layer 24 or by growing out of one of the perforations 30. As time progresses, roots 34 will spring forth from the seeds 26 and will grow through (penetrate) the substrate 22 to the soil below.

Although the mats 20 are not adhered to the soil 36 below, first owning to their weight, and later as a result of plant roots 34, they should not shift relative to the ground. In rare circumstances, it may however be necessary to place a shifted germination mat 20 back into position.

Finally, referring to Figure 8 there is illustrated an additional method of using the present plant seeds germination mats 20. In this instance it is desired to have the mature plants form a pattern, in the present example the word ZONE. Thus germination mats were severed such they formed the letters Z 38, O 40, N 42, E 44. An unlimited number of patterns and shapes can be formed in this manner. Moreover, should it be so desired, germination mats could be severed to fit in the area 46 surrounding the letters ZONE, yielding an entire patterned flower bed.

The above description of preferred embodiments should not be interpreted in a limiting manner since other variations, modifications and refinements are possible within the spirit and scope of the present invention. The scope of the invention is defined in the appended claims and their equivalents.

CLAIMS

1. A plant seed germination mat comprising:

   (a) a substrate, said substrate including a structurally integral layer comprising sphagnum moss particles;

   (b) a plurality of plant seeds on said substrate; and

   (c) a cover layer affixed to said substrate at least partially covering said substrate and said plant seeds, said cover layer capable of being gradually penetrated by a shoot growing from one of said plant seeds.

2. A plant seed germination mat as recited in claim 1, wherein said cover layer includes a structurally integral layer comprising cellulose fibres.

3. A plant seed germination mat as recited in claim 1, wherein said cover layer includes a structurally integral layer comprising sphagnum moss particles.

4. A plant seed germination mat as recited in claim 3, wherein said cover layer includes in a plurality of spaced apart perforations for facilitating the penetration of said cover layer by the shoot.

5. A plant seed germination mat as recited in claim 4, wherein said perforations are evenly spaced apart.

6. A plant seed germination mat as recited in claim 1, wherein a colour of at least portion of said cover layer approximates a colour of at least a portion of a flower of a plant grown from said seeds.

7. A plant seed germination mat as recited in claim 1, wherein said cover layer includes a zone capable of assuming at least a first colour when dry and at least a second colour when wet, for indicating the moisture content of the mat.

8. A plant seed germination mat comprising:

(a) a substrate, said substrate including a structurally integral layer comprising sphagnum moss particles; and

(b) a plurality of plant seeds incorporated into said substrate;

said substrate capable of being gradually penetrated by a shoot growing from one of said plant seeds.

9. A plant seed germination mat as recited in claim 8, wherein a colour of at least portion of said substrate approximates a colour of at least a portion of a flower of a plant grown from said seeds.

10. A plant seed germination mat as recited in claim 8, wherein said substrate includes a zone capable of assuming at least a first colour when dry and at least a second colour when wet, for indicating the moisture content of the mat.

11. A plant seed germination mat comprising:

(a) a structurally integral layer of sphagnum moss particles; and

(b) a plurality of plant seeds affixed to said layer with sufficient force to keep said seeds from separating from said layer when said layer is subjected to mechanical disturbances occurring during either one of rolling said layer upon itself and unrolling said layer.

12. A plant seed germination mat as recited in claim 11, wherein a colour of at least portion of said layer approximates a colour of at least a portion of a flower of a plant grown from said seeds.

13. A plant seed germination mat as recited in claim 11, wherein said layer includes a zone capable of assuming at least a first colour when dry and at least a second colour when wet, for indicating the moisture content of the mat.

14. A plant seed germination mat as recited in claim 1, 3, 8 or 11, wherein the mat is substantially free of non-biodegradable material.

15. A plant seed germination mat as recited in claim 1, 3, 8 or 11, wherein the mat includes a fertilizer.

16. A plant seed germination mat as recited in claim 1, 3, 8 or 11, wherein the mat includes a coloured zone indicating a variety of said plant seeds.

17. A plant seed germination mat as recited in claim 1, 3, 8 or 11, wherein the mat includes a coloured zone indicating an in use orientation of the mat.

18. A plant seed germination mat as recited in claim 1, 3, 8 or 11, wherein said plants seeds are grass seeds.

19. A plant seed germination mat as recited in claim 1, 3, 8 or 11, wherein said plant seeds are flowering plant seeds.

20. A plant seed germination mat as recited in claim 1, 3, 8 or 11, wherein said plant seeds are vegetable seeds.

21. A method of growing plants comprising the steps of:

(a) placing a plant seed germination mat as recited in any one of claims 1 to 20 on soil; and

(b) watering the mat.

22. A method of making a plant seed germination mat comprising the steps of:

(a) providing a substrate including sphagnum moss particles;

(b) delivering a plurality of plant seeds on the substrate;

(c) providing a cover layer on the plant seeds, the cover layer capable of being gradually penetrated by a shoot growing from one of the plant seeds; and

(d) affixing the cover layer to the substrate.

23. A method of making a plant seed germination mat as recited in claim 22, wherein the cover layer includes a structurally integral layer comprising cellulose fibres.

24. A method of making a plant seed germination mat as recited in claim 22, wherein the cover layer includes a structurally integral layer comprising sphagnum moss particles.

25. A method of making a plant seed germination mat as recited in claim 24, further comprising the step of perforating the cover layer to form a plurality of spaced apart perforations for facilitating the penetration of the cover layer by the shoot.

26. A method of making a plant seed germination mat as recited in claim 25, wherein the perforations are equally spaced apart.

27. A method of making a plant seed germination mat as recited in claim 22, further comprising the step of colouring at least a portion of the mat for indicating a variety of the plant seeds.

28. A method of making a plant seed germination mat as recited in claim 22, further comprising the step of colouring at least a portion of the mat for indicating an in use position of the mat.

29. A method of making a plant seed germination mat as recited in claim 22, further comprising the step of colouring at least a portion of the cover layer such that the colour of the cover layer approximates a colour of at least portion of a flower of a plant grown from the plants seeds.

30. A method of making a plant seed germination mat comprising the step of incorporating plant seeds into a structurally integral layer comprising sphagnum moss particles.

31. A method of making a plant seed germination mat comprising the step of affixing plant seeds to a structurally integral layer comprising sphagnum moss particles.

32. A method of making a plant seed germination mat as recited in claim 30 or 31, further comprising the step of colouring at least a portion of the mat for indicating a variety of the plant seeds.

33. A method of making a plant seed germination mat as recited in claim 30 or 31, further comprising the step of colouring at least a portion of the mat for indicating an in use position of the mat.

34. A method of making a plant seed germination mat as recited in claim 30 or 31, further comprising the step of colouring at least a portion of the mat to approximate a colour of at least portion of a flower of a plant grown from the plants seeds.

35. A method of producing a plant bed having a pattern, comprising the steps of:

(a) providing a first seed germination mat as recited in any one of claims 1 to 20;

(b) severing the first seed germination mat in accordance with the pattern; and

(c) positioning the severed first seed germination mat on soil in accordance with the pattern.

36. A method of producing a plant bed having a pattern as recited in claim 35, further comprising the steps of:

(a) providing a second seed germination mat as recited in any one of claims 1 to 20;

(b) severing the second seed germination mat in accordance with the pattern; and

(c) positioning the severed second seed germination mat on the soil in accordance with the pattern.

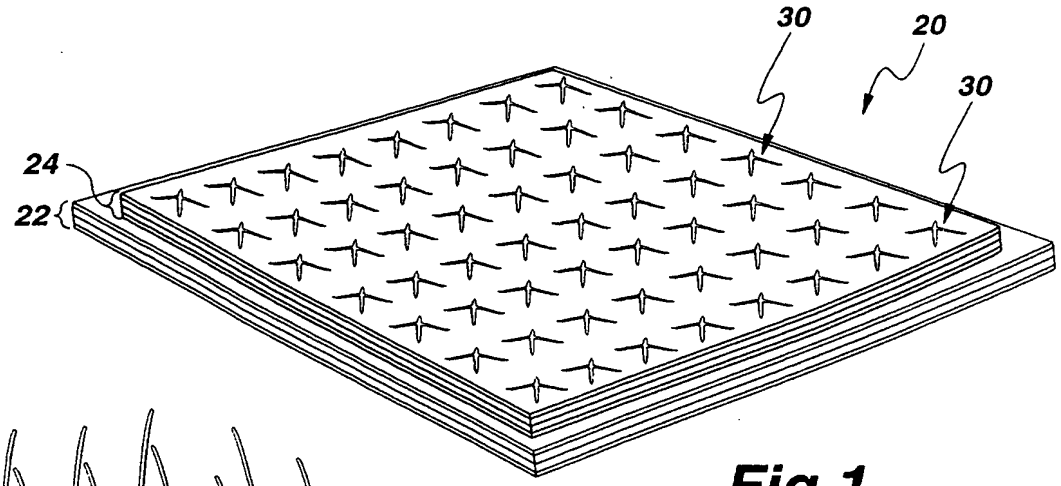

Fig.1

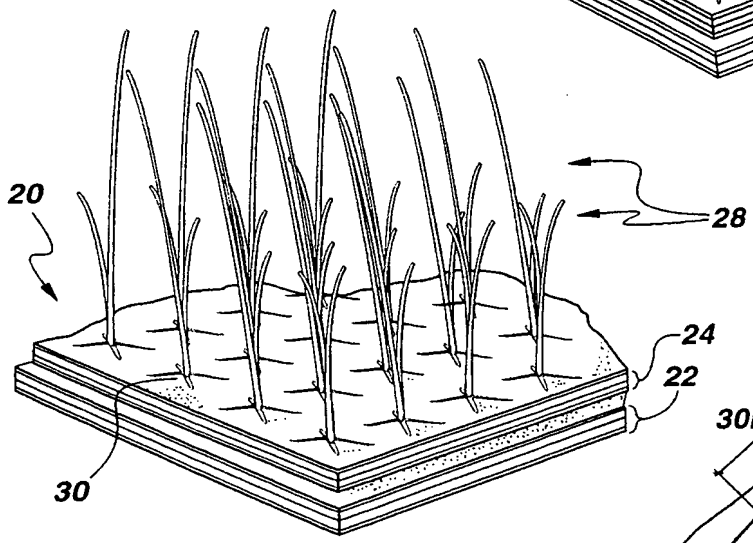

Fig.4

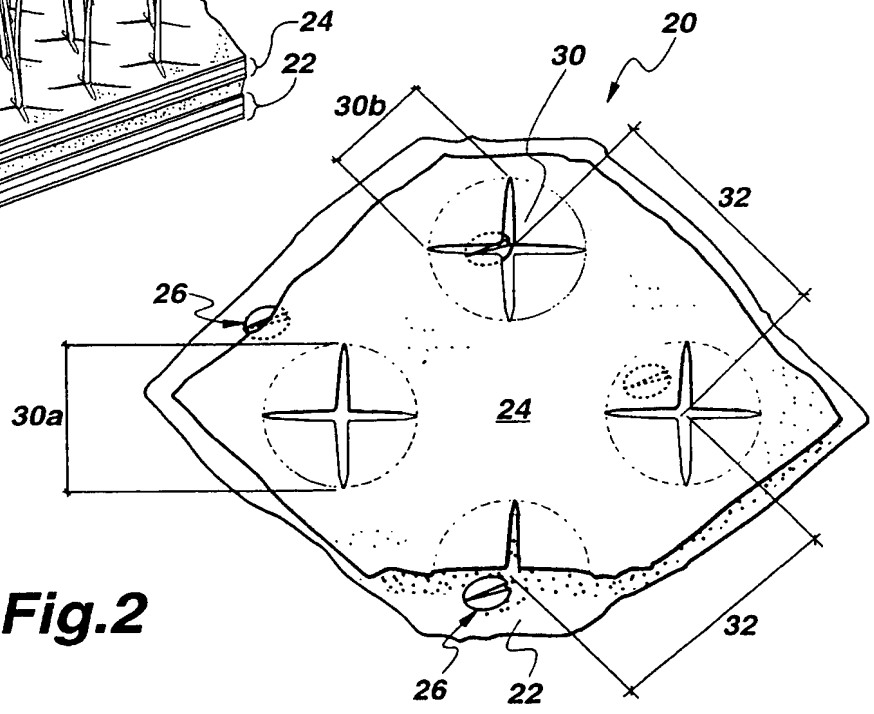

Fig.2

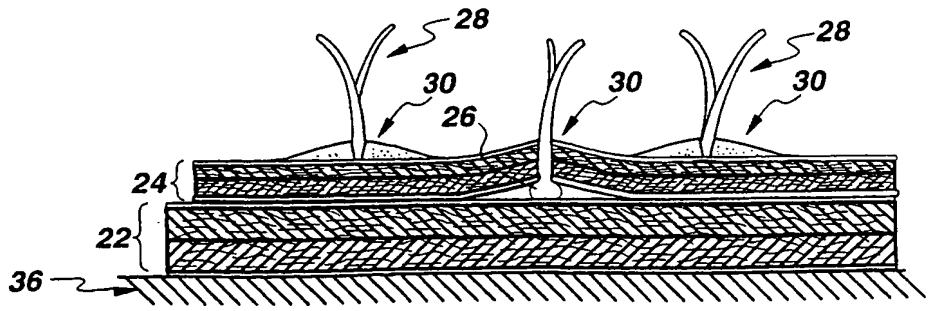

Fig.3

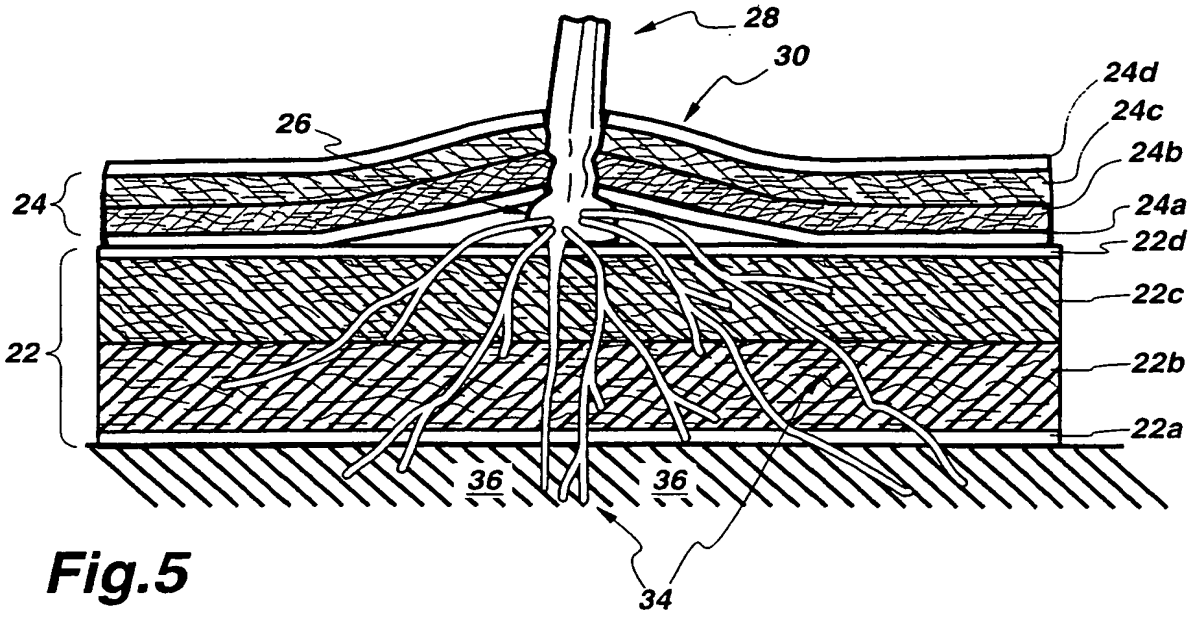

Fig.5

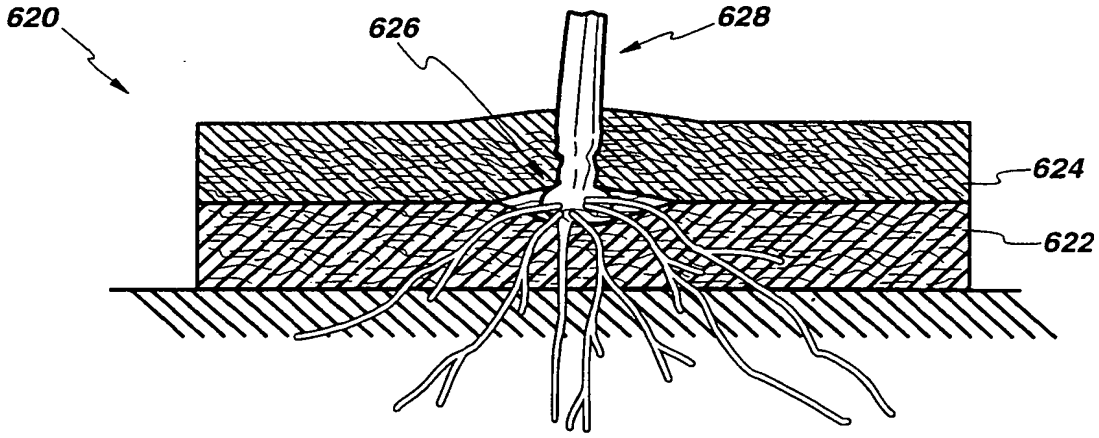

Fig.6

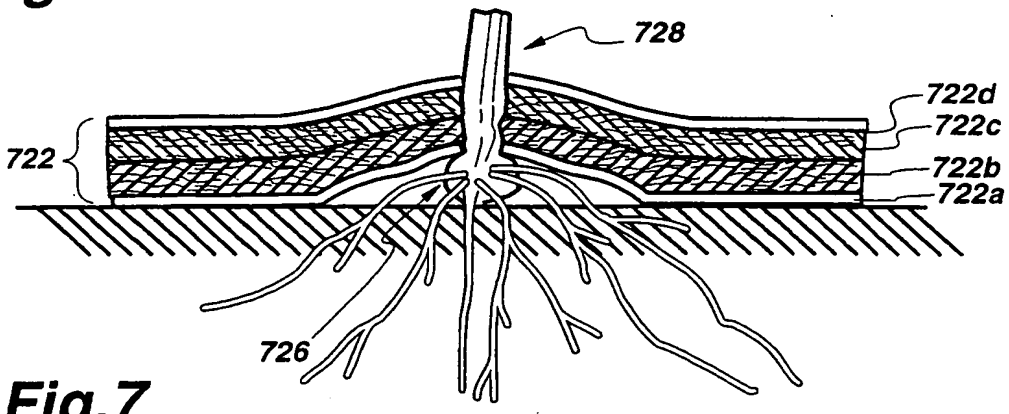

Fig.7

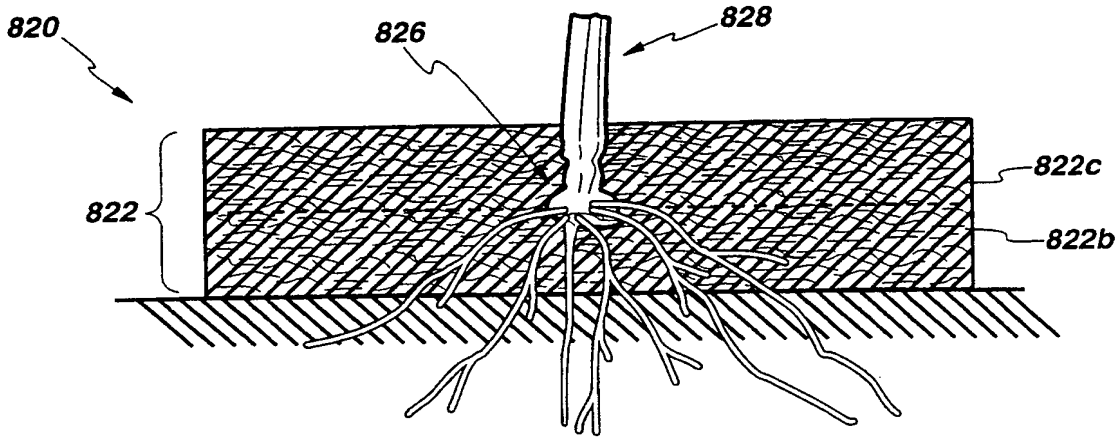

Fig.8

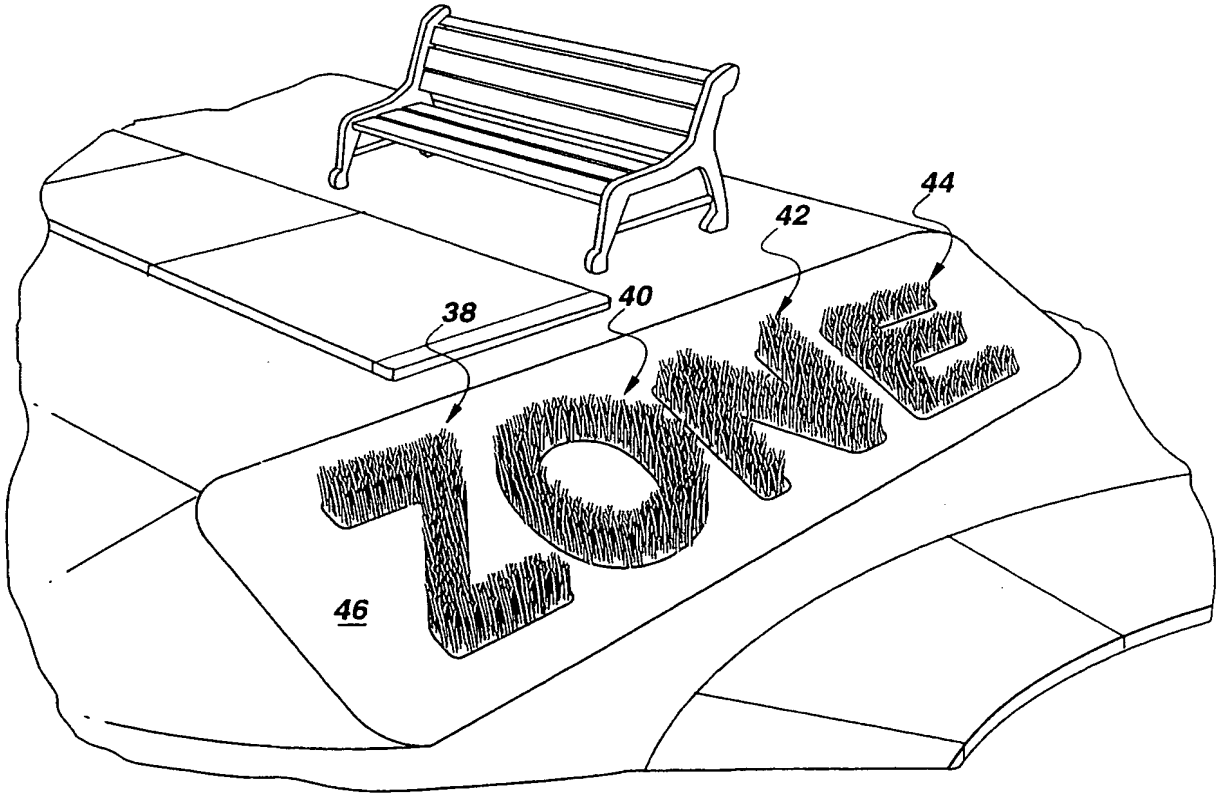

Fig.9

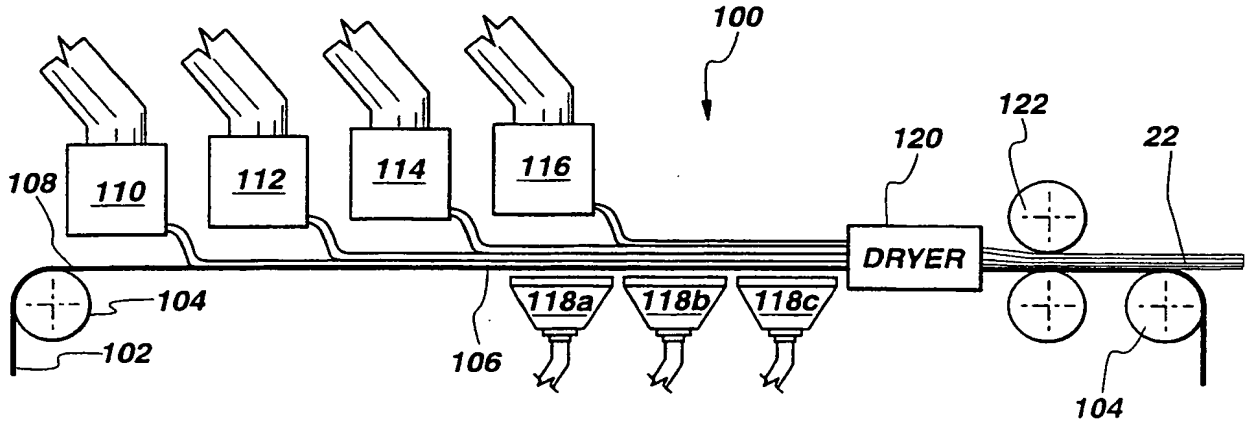

Fig.10

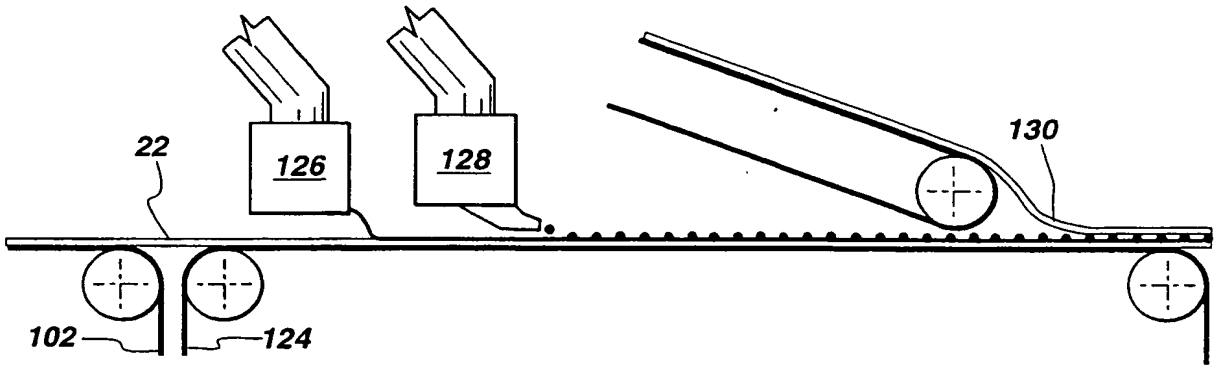

Fig.11

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 98/00561

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A01G1/00 A01C1/04

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A01G A01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 3 914 901 A (MULDNER LAWRENCE C) 28 October 1975 see the whole document ---	1,3,8, 11, 18-22, 24,30,31 2,4-7,9, 10, 12-17, 23, 25-29, 32-36
X A	US 5 301 466 A (EGAN MICHAEL A) 12 April 1994 see column 3, line 50 - column 4, line 6 see claim 4 see figure 1 --- -/--	8,11,21 1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
16 September 1998	28/09/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Baltanás y Jorge, R

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 98/00561

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